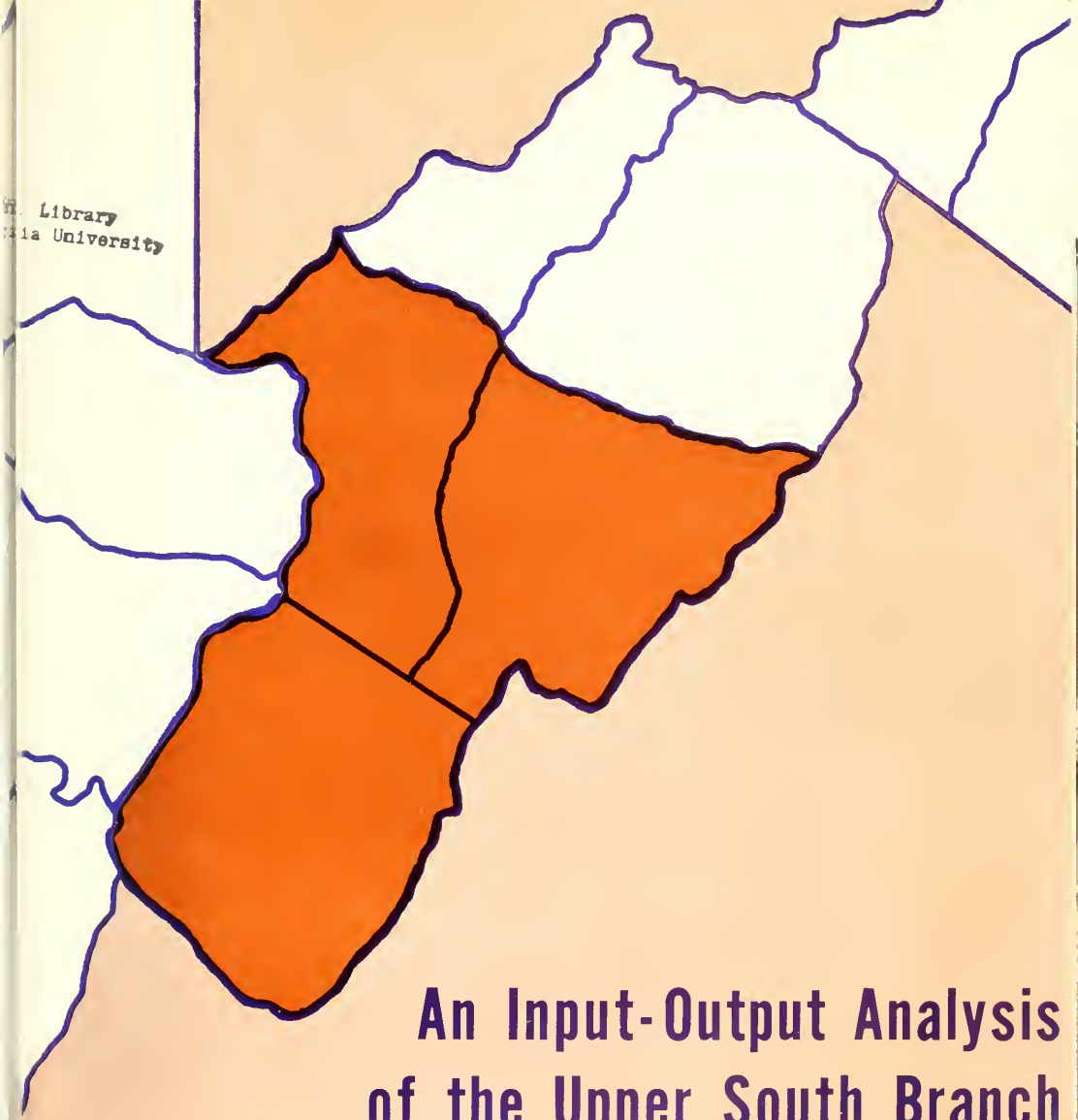

An Input-Output Analysis of the Upper South Branch Valley of West Virginia

West Virginia University
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AN INPUT-OUTPUT ANALYSIS OF THE UPPER SOUTH BRANCH VALLEY OF WEST VIRGINIA

Nelson L. Bills and Alfred L. Barr

West Virginia University
Agricultural Experiment Station

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MORGANTOWN

Contents

Summary

The objective of this study was to determine the economic contribution of different types of industries within a region and to determine the effects of an expansion or contraction of specific types of industry within a local community on income and employment.

The area included in the study was the Upper South Branch Valley (Grant, Hardy, and Pendleton counties) of West Virginia. The entire area was classified as rural, and over 40 per cent was classified rural-farm by the 1960 Census of Population. The three-county area had significant changes in the industrial composition of its labor force between 1950 and 1960. The per cent of the total labor force employed in agriculture declined from 49 per cent in 1950 to 31 per cent in 1960. Employment in other sectors of the local economy increased but not enough to offset these decreases. Total population for the three counties declined by 8.5 per cent and the size of the labor force declined by 10.9 per cent between 1950 and 1960.

Monetary transactions between 14 endogenous processing sectors were estimated for 1965. Deliveries (sales) to final demand, including local household consumption, capital formation, and exports, were determined for each endogenous sector. Purchases in excess of local interindustry transactions were allocated to the final payments sectors of the transactions table which included local household payments, depreciation allowances, and import payments.

The regional transactions table was computed from data obtained from primary and secondary sources. Data for 12 or 14 processing sectors were obtained by a field survey. A group survey was used to supplement data for the agricultural sector and secondary sources of information were used to meet other data requirements.

The processing quadrant of the transactions table was used to determine the impact of a change in final demand on local income and employment for each processing sector. The direct relationship between total gross output and input purchases was estimated for each processing sector. Indirect and induced requirements were estimated to determine the generative effect associated with a unit change in deliveries to final demand by each sector.

Type I income multipliers were computed for each processing sector. A Type I multiplier is the ratio of direct to the sum of direct and indirect changes in household income. These multipliers were used to estimate payments which directly and indirectly accrue to local households as a result of a unit change in direct household payments in each processing sector.

Type II income multipliers were also computed for each processing sector of the local economy. The Type II multiplier is the ratio of direct to the sum of direct, indirect, and induced changes in household income. The induced component is an estimate of payments to local households which result from adjustments required to meet changes in each sector's household consumption demand.

Dollar transactions between processing sectors were converted to employment equivalents for the purpose of deriving employment multipliers. Type 1 (the ratio of direct to the sum of direct and indirect employment) and Type II (the ratio of direct to the sum or direct, indirect, and induced employment requirements) employment multipliers were computed.

Variation in the degree of interindustry dependency was reflected in the relative sizes of the income multipliers. Agriculture, food manufacturing, communications and utilities, and wholesale and retail trade exhibited relatively strong interindustry linkages. Weak interindustry linkages, i.e., low income multipliers, were observed in the wood manufacturing, services, commercial banking, other finance, insurance, and real-estate sectors.

AN INPUT-OUTPUT ANALYSIS OF THE UPPER SOUTH BRANCH VALLEY OF WEST VIRGINIA

Nelson L. Bills and Alfred L. Barr

DECREASES IN POPULATION, employment opportunities and income in rural areas in West Virginia are of major concern to a number of public and private groups. In efforts to increase present funds and stimulate employment and income growth, considerable time and resources are being expended by groups at the local, state, and Federal level.

Efforts to increase local income and employment are often hampered by insufficient information about the economic structure of a region. There is a need to determine the economic contribution of different types of industries within a region and to determine the effects of an expansion or contraction of specific types of industry within the local community on income and employment.

A study was initiated at the West Virginia Agricultural Experiment Station to analyze the economic structure of the Upper South Branch Valley, including Grant, Hardy, and Pendleton counties in West Virginia. This bulletin represents the second and final report on the results of this research project.[1]

The Study Area

The Upper South Branch Valley of eastern West Virginia was selected for this study because agriculture is relatively important to the economy of the area; in 1964, over 29 per cent of the total personal income in the three counties was derived from the sale of farm products. Moreover, the socio-economic characteristics of the three-county area are relatively homogeneous. The study area, encompassing 1,757 square miles, contained a population of 25,705, or 1.38 per cent of the State total (Table 1), in 1960. There were 14.6 inhabitants per square mile, compared with 77.3 per square mile for the State.

[1]A previous bulletin summarized the socio-economic characteristics of the three-county area. James I. Stallings, S. Ford, and N. L. Bills, *The Resources of the Upper South Branch Valley*, W. Va. Agr. Exp. Sta. Bull. 551, June 1967.

TABLE 1

Total Population of the United States, West Virginia and the Upper South Branch Valley, 1930-60

Area	1930 (000)	1940 (000)	1950 (000)	1960 (000)
United States	122,775.0	131,669.0	150,679.0	179,323.0
West Virginia	1,729.2	1,901.9	2,005.5	1,860.4
Upper South Branch Valley	27.9	30.5	28.1	25.7
Grant County	8.4	8.8	8.7	8.3
Hardy County	9.8	10.8	10.0	9.3
Pendleton County	9.6	10.8	9.3	8.0

[1]Source: *U. S. Census of Population*, 1930-60.

The topography of the Upper South Branch Valley is highly variable. Elevations range from 725 feet to 4,860 feet. The relief of the area is generally rough but is characterized by relatively narrow flat valleys along rivers. Approximately 70 per cent of the total land area is in forest and over 15 per cent is federally owned (Table 2). Most of the federally-owned land in the three-county area is in the Monongahela and George Washington National forests. In 1958, 25.7 per cent of the total area was in cropland and pasture. According to the 1964 Census of Agriculture, approximately 57 per cent (640,700 acres) was in farms.

POPULATION OF THE AREA

In 1960, the entire population of the area was classified as rural non-farm and rural farm (Table 3), as all five incorporated places in the area had fewer than 2,500 inhabitants each. These five places contained almost 20 per cent of the total residents in 1960 (Table 4). The area has been subject to a declining population for the past two decades. From 1950 to 1960, population declined by 8.5 per cent in the three-county area while the population of the State declined 7.2 per cent (Table 6).

The Upper South Branch Valley has experienced out-migration during the past decade, the trend resembling that of the entire State during the period. Table 5 shows estimates of net migration by age group for the State and for each of the three study counties from 1950 to 1960. These data are defined as an estimate of net migration in that no information is available on total in-and-out-movements of population

TABLE 2

Major Uses of Land in West Virginia and the Upper South Branch Valley, 1958[1]

Major Use	West Virginia		Upper South Branch Valley	
	Acres (000)	Per Cent	Acres (000)	Per Cent
Cropland	1,521.1	9.9	79.8	7.1
Pasture	2,572.8	16.7	207.8	18.6
Forest	9,465.2	61.4	655.0	58.3
Federal	935.0	6.1	170.1	15.1
Urban	433.2	2.8	3.4	0.3
All Other	483.2	3.1	7.0	0.6
TOTAL LAND AREA	15,410.3	100.0	1,124.0	100.0

[1]Source: USDA SCS, *West Virginia Soil and Water Conservation Needs Inventory*.
[2]Includes forest land under federal ownership.
[3]Includes all water areas, farmsteads, idle land, wildlife areas, and other areas not classified.

TABLE 3

Urban, Rural Non-Farm, and Rural Farm Population: United States, West Virginia, and the Upper South Branch Valley, 1960[1]

Item	United States	West Virginia	Upper South Branch Valley
		Per Cent	
[illegible]	69.9	18.0	0.0
[illegible]	22.6	60.4	59.4
[illegible]	7.5	21.6	40.6
[illegible]	100.0	100.0	100.0

TABLE 4

Population of Incorporated Places in the Upper South Branch Valley, 1960

Item	County	Population	
		Total	Per Cent of Total
Total Population		25,705	100.0
Incorporated Places		5,044	19.6
Bayard	Grant	484	1.9
Petersburg	Grant	2,079	8.1
Moorefield	Hardy	1,434	5.6
Wardensville	Hardy	289	1.1
Franklin	Pendleton	758	2.9

[1]Source: *U. S. Census of Population*, 1960.

TABLE 5

Estimated Net Migration Rate by Age Groups; West Virginia, Grant, Hardy, and Pendleton Counties, 1950-60[1]

Age Group	Per Cent of 1950 Population			
	W. Va.	Grant	Hardy	Pendleton
All ages	—19.3	—17.9	—17.2	—22.0
0— 4	— 7.1	— 6.7	— 4.3	+ 0.4
5— 9	—15.4	—16.0	— 4.3	—10 0
10—14	—17.0	—18.2	—13.2	—15.7
15—19	—22.8	—25.5	—27.3	—27.7
20—24	—42.9	—47.6	—49.0	—56.6
25—29	—39.3	—40.3	—45.6	—54.9
30—34	—27.0	—26.4	—19.5	—29.6
35—39	—22.4	—20.8	—17.0	—20.9
40—44	—17.2	—10.9	— 9.0	—15.8
45—49	—14.2	— 3.7	—15.5	—14.6
50—54	—12.1	— 5.4	— 5.1	— 8.3
55—59	—11.0	— 4.7	— 3.1	—14 0
60—64	— 7.0	— 0.0	— 7.8	— 8.6
65—69	— 7.0	— 9.2	— 4.9	—10.0
70—74	— 4.5	— 0.3	— 3.6	— 7.7
75+	— 4.2	— 5.4	— 4.8	— 7.7

[1]Source: USDA-ERS, *Net Migration of the Population, 1950-60, by Age, Sex, and Color*

during the specified period.[2] Each county experienced net migration of more than minus 17 per cent during the 10-year period. Pendleton County, with a net migration rate of minus 22 per cent, had a greater loss of population than did either of the other counties during this period.

LABOR FORCE OF THE AREA

The size of a region's labor force is closely related to the size of its population, and changes normally occur in the same direction. Table 6 presents data on changes in population, size of the labor force, and the rate of participation in the labor force for 1950 and 1960. The Upper South Branch Valley incurred a proportionately smaller change in its labor force than in its total population during the 10-year period. However, the same situation appears to exist in both the State and the nation. In 1960, 31.6 per cent of the population of the three counties was in the

[2]*Net Migration of the Population, 1950-1960*, p. V

TABLE 6

Total Population, Labor Force, and Labor Force Participation Rates, United States, West Virginia, and Upper South Branch Valley, 1950-60

Item	United States			West Virginia			Upper South Branch Valley		
	1950	1960	Change 1950-60	1950	1960	Change 1950-60	1950	1960	Change 1950-60
			Per Cent			Per Cent			Per Cent
Total Population	150,697,300	179,323,100	19.0	2 005,500	1 860,400	— 7.2	28.100	25,700	— 8.5
Male	74,833,200	88,301,900	18.0	1,006,300	914,900	— 9.1	14 300	12,900	—10.0
Female	75,864,100	91,021,200	20.0	999,200	945,500	— 5.4	13 800	12,800	— 7.0
Total Labor Force	60,053,900	69,877,400	16.4	660,200	588,000	—10.9	9.100	8,100	—10.9
Male	43,553,300	47,467,700	9.0	522,200	425,600	—18.5	7 800	6,400	—18.7
Female	16,500,600	22,409,700	35.8	138,000	162,400	17.5	1,300	1.700	37.0
Participation Rate %	39.9	39.0	—	32.9	31.6	—	32.4	31.6	—
Male	58.2	53.8	—	51.9	46.5	—	54.7	49.4	—
Female	21.8	24.6	—	13.8	17.2	—	9.2	13.6	—

[1]Source: *U. S. Census of Population*, 1950-60.

labor force; for the nation, 39.0 per cent. Much of this differential is due to the smaller proportion of females in the labor force in the Upper South Branch Valley. More than 24 per cent of the nation's females was in the civilian labor force in 1960, compared to only 13.6 per cent in the Upper South Branch Valley.

The net decrease in the size of the civilian labor force between 1950 and 1960 in the three-county area was due to a reduction in the number of males in the labor force.

The average age of members of the labor force was greater for the area than for either the State or the nation in 1960 (Table 7). Eight per cent of the labor force in the study area was over 65 years of age in 1960, but only 4.2 per cent of the State's and 4.6 per cent of the nation's labor force were over 65.

Over 31 per cent of the total labor force was employed in agriculture in 1960 (Table 8). Despite sizable declines in agricultural employment, the agricultural sector remained the largest single source of employment in the three-county area. The proportion of the labor force employed in manufacturing, trade, and services, was below the national and State average. The area has experienced an increase in employment in non-agricultural sectors during the past three decades, but this increase has not been great enough to offset employment losses in agriculture.

Methodology Used

Alternative methods exist for analyzing the economic structure of a small area. A decision on the appropriate methodology to use must be made in view of specific objectives and weighted against the time and costs involved in making the analysis.

The objectives of this study were to determine the degree of interdependence existing between industrial sectors in the region and to determine the impact of a change in production in each sector on the income and employment of the area. The various sectors of an area economy do not respond uniformly to changes in demand for locally produced goods and services. Income and employment in one sector may contract with expansion in other sectors, or the rates of expansion may differ. Thus, a measure of the interrelationships between sectors of a region, as well as a measure of the over-all response to a given stimulus (change in demand), is needed.

A regional adaptation of a Leontief type input-output model was used in this study. The model provided the framework for isolating the linkages between industrial sectors and also for computing income and employment multipliers for each sector.

THE TRANSACTION TABLE

Input-output analysis is a system of accounts which quantifies the monetary value of goods and services exchanged between sectors of an economy. Sales of output by one sector of the economy are purchases of inputs by other sectors. A transactions table, in which sales and purchases between sectors are recorded, is used to determine the degree of interdependency in the local economy.

TABLE 7

Composition of the Civilian Labor Force by Age, United States, West Virginia, and the Upper South Branch Valley, 1960[1]

Age Group	United States	West Virginia	Upper South Branch Valley
		Per Cent	
Over 17 years	96.7	97.0	96.7
Over 25 years	83.7	84.5	84.3
Over 35 years	62.8	63.8	64.7
Over 45 years	39.0	39.5	42.4
Over 65 years	4.6	4.2	8.0
ALL AGES	100.0	100.0	100.0

[1]Source: *U. S. Census of Population*, 1960.

TABLE 8

Total Employment and Rate of Employment by Industrial Sector, United States, West Virginia, and the Upper South Branch Valley, 1950-60

Industrial Sector	United States		West Virginia		Upper South Branch Valley	
	1950 (000)	1960 (000)	1950	1960	1950	1960
Agriculture	6,893.6	4 252.8	61 439	23,487	4,353	2,315
Mining	928.3	653.9	134 329	59,098	169	89
Construction	3 398.0	3,817.7	32,177	29,285	506	666
Manufacturing	14,453.1	17,529.8	119,162	125,717	1,013	1,267
Transportation, Communications, Utilities	4,346.5	4,458.5	53,921	47 331	298	347
Trade	10 388.7	11,797.9	96,952	97,128	844	1,086
Finance, Insurance, Real Estate	1,882.7	2,695.5	9,984	12,450	42	98
Services	10,119.0	13,542.4	93,422	107,008	1 012	1.100
Public Administration	2,490.7	3,194.3	16 580	19 006	197	271
All Other	903.0	2,703.7	10,306	17 704	285	168
TOTAL EMPLOYMENT	55 803.5	64 646.6	628,272	538,214	8,719	7,407
			Employment Rate			
			Per Cent			
Agriculture	12.4	6.6	9.8	4.4	49.9	31.3
Mining	1.7	1.0	21.4	11.0	1.9	1.2
Construction	6.1	5.9	5.1	5.4	5.8	9.0
Manufacturing	25.8	27.1	19.0	23.4	11.6	17.1
Transportation, Communications, Utilities	7.8	6.9	8.6	8.8	3.4	4.7
Trade	18.6	18.2	15.4	18.1	9.7	14.7
Finance, Insurance, Real Estate	3.4	4.2	1.6	2.3	0.5	1.3
Services	18.1	21.0	14.8	19.8	11.6	14.8
Public Administration	4.5	4.9	2.6	3.5	2.3	3.6
All Other	1.6	4.2	1.7	3.3	3.3	2.3
TOTAL EMPLOYMENT	100.0	100.0	100.0	100.0	100.0	100.0

Source: U. S. *Census of Population*, 1950-60.

In Figure 1 a graphic representation of an input-output transactions table is presented.[1] A total of "n" industries or sectors are listed in the upper left hand corner of the table (Quadrant I). This quadrant is referred to as the processing sector or section of the table. All entries in [illegible] of the table represent interindustry transactions (purchases and sales) [illegible] in the region and consid[illegible] to the model. The interindustry [illegible] column represents a [illegible] listed in the corresponding [illegible] by industry 1 to industry 2 represents a purchase by industry 2 from industry 1. Therefore, each column entry in Quadrant I for industry 1 represents that industry's purchase during the specified period from other endogenous sectors of the economy. In turn, all row entries in Quadrant I for industry 1 represent that industry's sales to other endogenous sectors.

Quadrant II (Figure 1) is composed of the final demand sectors. Entries in this quadrant represent sales by industries 1, 2, 3, . . ., n to exogenous final demand sectors 1, 2, 3, . . ., m. Final demand sectors are unexplained by the

[illegible] *Economic*, p. 16.

model and represent sales to final users of the goods and services produced within the region. The number of final demand sectors can and does vary between different regional economies. Exports, i.e., sales by local industries to the rest of the world, deliveries to local household consumption, and capital formation are usually assigned to final demand. The row total, which is the sum of all endogenous transactions, plus sales to final demand, is the total gross output for each industry in the processing quadrant.

In Quadrant III (Figure 1), all purchases by industries 1, 2, 3, . . ., n from sources not included in the processing sector are recorded. Sectors in this quadrant are referred to as the final payment sector or section of the table and are represented by one or more rows. Again, the number of final payments sectors can vary depending upon the objectives of the study; but typical entries include depreciation expenditures, payments to local households, government payments (normally in the form of taxes), and all imports or purchases from the rest of the world.

The remaining quadrant of the table, Quadrant IV, represents direct inputs of goods and services to final demand which are not produced by industries in the process quadrant, or Quadrant I. An example of this type of transaction would be government transfer payments to local households.

The accounting procedure employed in the analysis is stated as follows:

$$(1)\quad X_i = X_{ij} + X_f$$

$$(2)\quad X_{ij} = a_{ij} X_j$$

$$(3)\quad a_{ij} = \frac{X_{ij}}{X_j}$$

$$(4)\quad X_i = \sum_{J=1}^{n} a_{ij} (X_j) + X_f$$

Where X_i = total output for sector i
X_j = total output for sector j
X_{ij} = transactions between i and j
X_f = exogenous sectors
i,j = 1, 2, 3, . . ., n
f = 1, 2, 3, . . . m

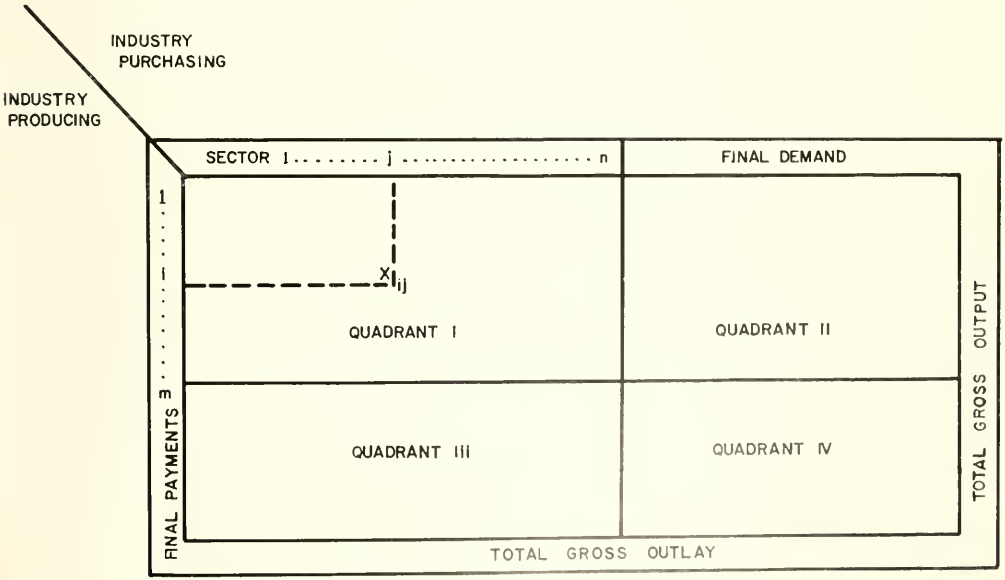

FIGURE 1. Graphic Description of an Input-Output Transactions Table

As this procedure states, the economy is comprised of n+m sectors, of which 1, 2, 3, . . ., n are endogenous or explained by the model. The remaining sectors (X) are exogenous or not explained by the model. Equation (1) states that total output (X_i) is the sum of all endogenous sales by sector i plus sales to the exogenous sectors. The objective of the analysis was to determine the existing relationship between output of a sector (X) and its transaction with other endogenous sectors. Thus, equation (2) states that the demand for the output of sector i by sector j is a function of the output in sector j. The functional relationship (a_{ij}), subsequently referred to as a technical coefficient, expresses the relationship between output in sector j and its purchases from sector i (equation 3). Thus, by substitution, total output of sector i (X_i) is shown in equation (4) to be the sum of all input requirements from all sectors j plus the value of output moving to the exogenous sector (X_i).

TECHNICAL COEFFICIENTS

Each coefficient is an estimate of the purchase per unit of output by a given sector in the processing quadrant from another sector in this quadrant. By adding the coefficients for any column, total interindustry requirements by a given sector to produce a unit of output can be determined.[4]

The coefficients represent only the direct requirements per unit of output by sectors and do not include any indirect or generated requirements. An increase in final demand for the output of one endogenous sector requires that the given sector increase its purchases of the output of other sectors. To increase their output, these other sectors must, in turn, purchase more of the output of still other sectors. The sum of all generated output resulting from the increase in final demand for the output of the given sector is referred to as the multiplier effect. Computation of the total generative or multiplier effect of [illegible] change in final demand for each sector of [illegible] economy was accomplished [illegible] mathematical process known as [illegible]

ASSUMPTIONS OF INPUT-OUTPUT ANALYSIS

In its general form, an input-output model establishes a specific set of input-output relationships between sectors.[5] It is therefore assumed that:

(1) Structural relationships between economic sectors can be identified by a unique set of input-output coefficients.[6]
(2) Each commodity is supplied by a single industry or sector of production.
(3) The inputs purchased by each sector are a function of the level of output of that sector only.
(4) The total effect of carrying on several types of production is the sum of separate effects, i. e., there are no external economies of scale.
(5) A unique set of regional trading patterns exists, i.e., the geographical distribution of sectoral sales and purchases is fixed in the transactions table.

ADVANTAGES OF INPUT-OUTPUT ANALYSIS

A major advantage of input-output analysis is that there is no requirement as to the number of sectors included in any quadrant in the transaction table. The only requirement is that there must be one row for each column in the processing quadrant (Quadrant I, Figure 1). The number of sectors included in any quadrant can be determined by the industrial composition of the region, availability of data, or detail of results desired. For example, deliveries to final demand can be divided into such entries as households, government, and exports, with exports further separated on the basis of destination of the products. On the other hand, all deliveries to final demand can be aggregated into a single entry.

Several objectives can be accomplished with input-output analysis by shifting sectors from one quadrant to another. For example, it is possible to shift a sector such as households from the final demand quadrant to the pro-

[illegible] total gross output for each processing sector.

[illegible] degree of competition, and (3) the state of technology are fixed.

cessing quadrant if the objective is to explain the level of household income. Conversely, if the objective is to analyze the interindustry effects of changes in residential construction activity, the residential construction industry can be changed from a processing to a final demand sector.[7]

LIMITATIONS

Data developed for a regional transactions table cover interindustry sales and purchases within the local economy during a given period of time. The ability of fixed coefficients derived from these data to accurately depict the response of the local economy to a change in final demand must be considered in evaluating the results of a regional input-output analysis. A change in technology, regional trading patterns, or the product mix associated with an expansion or contraction of final demand affects the accuracy of the results of the study.

Data requirements for a transactions table are considerable. Therefore, the quality and quantity of available data also affect the reliability of relationships established in the transactions table.

VALUATION OF OUTPUTS AND INPUTS

Input-output analysis is a study of the flows of goods and services within a region. These flows are usually stated in monetary terms. Value of output is measured in terms of producer's prices rather than purchaser's prices.[8] The difference between the two values represents items such as transportation costs, wholesale and retail trade margins, and excise taxes.[9]

In most transactions tables, commodities or groups of commodities are charged directly to the sector using the commodity. This requires that the transportation and trade, and insurance sectors of the economy be margined—that is, only the value added to goods through provision of time and place utility is attributed to these sectors. Therefore, total gross output for these sectors is defined as total sales less the cost of goods sold. A direct allocation to the consuming sector is made for goods for resale from these sectors. This procedure indentifies the direct linkages between the producing and purchasing sectors.

CAPITAL TRANSACTIONS

Sales and purchases between productive sectors of an economy can take two forms: (1) transactions on current account, i.e., purchases of goods and services which are consumed during the current period; and (2) transactions on capital account. All sales by firms in the processing sectors of the matrix on capital account are recorded in a capital formation column in Quadrant II of the transactions table (Figure 1). All expenditures by firms in the processing sectors on capital account are summarized in a capital row in Quadrant III. In effect, the capital row records allocation of funds by sector to depreciation expenditures during the base period. All other rows and columns in the table show flows of goods and services on current account.

The Upper South Branch Transactions Table

Firms in the study area were grouped into the 14 processing sectors presented in Table 9. The composition of each sector is given below.

(1) The agriculture sector includes all operations engaged in agricultural production such as livestock, crop, and fruit or vegetable farms, and also includes hatcheries, artificial inseminators and veterinarians, and others who provide service to farming operations on a contract or fee basis.

(2) The mining sector includes those establishments engaged in coal mining, limestone quarrying, and the extraction of crude petroleum and natural gas.

(3) The contract construction sector includes those firms engaged in the construction of buildings, special trade contractors engaged in specialized construction activities such as plumbing, painting, electrical work and carpentry and general contractors.

[7] Miernyk, William H. *The Elements of Input-Output Analysis*, p. 16.
[8] Evans and Hoffenburg, "The Interindustry Relations Study for 1947," *Survey of Current Business and Statistics*, p. 103.
[9] *Ibid.*, p. 104.

(4) The food manufacturing sector includes all establishments engaged in either the slaughter, dressing, preparation or packing of meats or meat products (including poultry); the manufacture or processing of dairy products; the manufacture of grain products such as flour for human consumption or prepared feeds for livestock or poultry; the manufacture of bakery products; or the manufacture of bottled and canned soft drinks.

(5) The apparel manufacturing sector includes those establishments engaged in producing clothing and fabricating products by cutting and sewing purchased textile fabrics.

(6) The wood and wood products sector includes firms engaged in the cutting of timber or pulpwood; sawmills, planing mills, plywood mills and others engaged in producing wood basic materials; establishments engaged in manufacturing finished articles, including furniture, made of wood or wood substitutes.

(7) All firms engaged in printing and publishing, the production of leather and leather products, and the production of stone, clay, glass or concrete products were grouped together into a single sector called other manufacturing.

(8) The transportation sector includes all local trucking activity, plus the stockyard operations in the area.

(9) The communications and utilities sector includes electrical companies, telephone companies, a radio station, and a firm which generates electricity.

(10) All wholesale and retail trade in the three-county area was aggregated into a single wholesale and retail trade sector.

(11) Commercial banking establishments were included in the commercial banking sector.

(12) The other finance, insurance and real estate sector includes credit agencies (other than banks), insurance agencies, and real estate

[illegible] service sector includes establish[illegible]ls and other lodging places; [illegible] personal, business, [illegible] services; medical, legal, [illegible]ional and mis[illegible] institutions

(14) The local government sector includes all economic activity originating from county and municipal governments; public school operations were also included in this sector.

The transactions table developed for the three-county area included three exogenous sectors:

(1) The households sector. Included in the household column of the table are all sales of goods and services by local business establishments to local households. In turn, all payments to local households by local businesses in the form of wages, salaries, proprietary income, dividends, rents and business transfers are included in the households row of the table.

(2) All transactions on capital account. All sales by local processing firms to final users of local goods and services for new capital formation are given in the gross private formation column of the table. In turn, all expenditures on capital account (depreciation allowances) are included in the other exogenous row of the table.

(3) All transactions with the rest of the world. All sales by local industry to the rest of the world are included in the exports column of

TABLE 9

Sectors and Corresponding Standard Industrial Classification Codes (S.I.C.) Included in the Upper South Branch Transaction Table

Sector Name	S.I.C. Codes[1]
Agriculture	0110 - 0729
Mining	1010 - 1499
Contract Construction	1510 - 1799
Food Manufacturing	2010 - 2099
Apparel Manufacturing	2310 - 2319
Wood and Wood Products	2410 - 2599
Other Manufacturing	2710 - 2799
	3110 - 3199
	3210 - 3299
Transportation	4010 - 4789
Communications and Utilities	4810 - 4971
Wholesale and Retail Trade	5010 - 5999
Commercial Banking	6020 - 6028
Other Finance, Insurance, Real Estate	6110 - 6799
Services	7010 - 8999 Except 8211
Local Government	9301 - 9390 8211

[1] The Standard Industrial Classification Codes are published in the *Standard Industrial Classification Manual*, Office of Statistical Standards, Bureau of the Budget, 1967.

the table. All purchases by local establishments from the rest of the world (imports) are included in the other exogenous row. As only local county and municipal government activity is included in the endogenous sector of the transaction table, all transactions by local residents and business establishments with State and Federal governmental units are included as exports and imports.

Data Collection

Data pertaining to the size and distribution of local interindustry sales and purchases are not directly available in published sources. Therefore, primary data were secured to supplement information from secondary sources. A field survey of a sample of local business establishments was used in all sectors of the economy with the exception of agriculture, communications, utilities, and local governmental units. A group survey was used to supplement secondary data in the agricultural sector. Secondary sources of information were used to obtain the data required for all other sectors not covered by the field and group survey. In addition, secondary sources of data were employed to obtain estimates for the households sector.

Table 10 presents the total number of establishments, sampling rate, and number of establishments interviewed in the field survey. The sampling rate varied from 10 per cent in the trade and services sectors to 100 per cent in th commercial banking sector. With the exceptio of the manufacturing, mining, and commercia banking sectors, establishments were randoml selected. Sufficient data were available in th mining and manufacturing sectors to identif establishments which dominated a sector i terms of employment and output. These estal lishments were selectively included in the sam ple to insure their coverage. Additional firm were randomly selected to meet the samplin rate specifications. Two or more firms wer selected from each two-digit classification. Sixt of the 93 firms selected provided the informa tion requested (Table 10).

A group survey was used to supplement sec ondary data on the agricultural sector. A meet ing was held with farm operators and the loca county agent in each of the three counties in th study area. An effort was made to select group of farm operators who were geographically dis tributed throughout each county, and a tota of 22 farm operators participated in the thre groups. Each farm operator filled out a question naire concerning the geographical and sectora distribution of revenues and expenditures for hi farming operations during 1965. In addition each group discussed the geographical distri bution of sales of a series of farm commoditie for all farms in the county. In this manner, eacl group allocated all sales of farm products b type of product for the county in 1965.

TABLE 10

Total Number of Establishments, Sampling Rate, and Completed Interviews by Two-Digit S.I.C.

Sector	S.I.C.	Estimated Number of Establishments[1]	Sampling Rate No.	Sampling Rate %	Number Interviewed	Per Cent Interviewed
Agricultural Services	07	9	4	45.0	3	33.3
Mining	12-14	13	9	70.0	4	30.7
Contract Construction	15-17	22	6	25.0	0	0.0
Manufacturing	19-39	50	23	45.0	15	30.0
Transportation	42-47	15	4	25.0	2	13.3
Trade	50-59	220	24	10.0	19	8.6
Commercial Banks	60	5	5	100.0	4	80.0
Other Finance, Insurance, Real Estate	61-65	23	5	20.0	2	8.7
Services	70-89	116	13	10.0	11	9.5
TOTAL	---	473	93	20.0	60	12.7

[1]Estimate compiled from a master file of business establishments.

Matrix Construction

Actual construction of the transactions matrix involved the reconciliation of data independently derived for each processing sector. For each sector the sales to and purchases from each sector were determined. Each endogenous sale is by definition also an endogenous purchase. Thus, a convenient check was available on all endogenous transactions.

Without exception, estimated sales by industry i to industry j differed from estimated purchases by industry j from industry i. When the reason for the difference could not be determined, data from the source judged to be the more reliable were used. More data were available from some sectors than from others and the quality of the data was judged to be better for some sectors than for others. For example, retailers were usually able to quantify and trace the distribution of business purchases from their records. On the other hand, they were forced to estimate the distribution of sales during the same period.

No cross-checks were available for exogenous sectors. For example, estimates of sales by the trade sector to local households could not be compared with data on the sectoral distribution of local household expenditures. Also, it was impossible to independently check the magnitude of imports and exports by sector.

Analysis of the Local Economy

The transactions table for the Upper South Branch economy for 1965 is presented in Table 11. The northwest portion of the table is the processing quadrant. Sectors in this quadrant are endogenous. All other sectors of the table are exogenous. Columns labeled "households," "gross private capital formation," and "exports" comprise the final demand sectors. Rows labeled "households" and "other exogenous" comprise the final payments sectors.

Each column entry in the table represents a purchase by the sector named at the top of the column from the sector named at the left. In turn, each row entry represents a sale by the

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Industry Producing	Agriculture	Mining	Construction	Food Manuf.	Apparel Manuf.	Wood Manuf.	Other Manuf.	Transportation
Agriculture	715.1	0	0	915.1	0	80.5	0	1.5
Mining	85.2	0	44.0	3.8	.4	0	24.6	0
Construction	75.7	4.0	65.0	0	0	0	2.5	0
Food Manuf.	2,855.1	0	0	9.8	0	5.0	0	3.9
Apparel Manuf	0	0	0	0	0	0	0	0
Wood Manuf	95.0	1.5	15.0	0	0	0	0	0
Other Manuf.	8.2	0	13.5	9.1	0	0.1	0.3	1.6
Transportation	13.3	319.0	10.3	4	0	7.5	3.4	0
Comm. Utilities	195.1	64.7	18.6	15.8	9.1	34.1	21.1	14.9
Retail, Wholesale Trade	816.4	39.4	105.1	19.4	.6	13.9	10.3	66.7
Comm. Banking	125.0	.9	33.1	3.9	0	7.4	4.1	24.1
Other Finance Ins. R. Est	30.1	1.7	6.7	0.6	0.1	2.1	.5	3.5
[illegible]	154.6	2.7	23.3	5.1	0.7	18.9	10.3	22.8
[illegible]	192.2	7.5	2.3	25.5	0.6	2.1	6.0	3.3
[illegible] ENDOGENOUS	5,421.0	171.1	397.7	1,068.8	11.5	172.2	83.1	142.3
[illegible] EXOGENOUS	3,075.7	3,529.1	2,413.9	721.9	327.9	1,530.9	131.7	872.9
[illegible] EXOGENOUS	10,721.8	3,977.0	3,800.4	6,517.4	1,949.8	2,258.7	1,123.8	552.6
[illegible] GROSS OUTLAY	19,218.5	7,977.5	11,612.0	8,308.1	2,289.2	3,961.8	1,638.6	1,567.8

industry named at the left to the sector named at the top. Therefore, an examination of the sales distribution of a given processing sector involves a movement across that industry's row in the transactions table. An examination of the expenditure pattern of a specific processing sector involves a movement down that industry's column.

Data in the exogenous sectors of the table provide considerable information on the economic structure of the area's economy. Figure 2 shows the percentage of total gross output by processing sector, which represents a delivery of locally produced goods and services to final demand. Deliveries to final demand as a per cent of total gross output varied from 100 per cent in apparel manufacturing to 58.5 per cent in mining. More than 84 per cent of total gross output originating in all processing sectors was delivered to final demand.

A small area economy is usually a relatively open economy, i. e., a relatively large proportion of all economic transactions is made with the rest of the world. Figure 3 shows the proportion of gross output exported by each processing

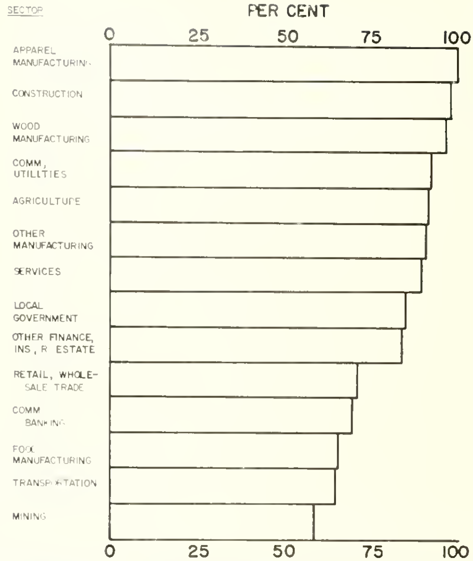

FIGURE 2. Deliveries to Final Demand as a Per Cent of Total Gross Output by Industrial Sector

11

Table, 1965 (Thousands of Dollars)

RCHASING

	Retail, Wholesale Trade	Comm. Banking	Other Finance, Ins., R. Est.	Services	Local Govt.	Total Endogenous	Households	Gross Private Capital Formation	Exports	Total Exogenous	Total Gross output
0	0	0	0	0	0	1,772.2	1,035.9	0	16,410.4	17,446.3	19,218.5
4.0	32.0	0	1.0	2.0	8.4	3,305.1	117.7	0	4,521.4	4,672.4	7,977.5
0	79.5	4.8	0	0	8.8	210.3	175.1	10,703.0	493.6	11,371.7	11,612.0
0	4.8	0	0	0	6.2	2,884.8	160.0	0	5,263.3	5,423.3	8,308.4
0	0	0	0	0	0	0	0	0	2,289.2	2,289.2	2,289.2
0	0	0	0	0	0	111.5	0	14.2	3,806.1	[illegible]	3,961.8
0	73.5	3.3	2.0	1.8	17.0	160.1	127.1	113.9	1,236.9	[illegible]	1,638.6
0	122.0	0.2	0	8.3	6.2	551.1	67.1	0	[illegible]	[illegible]	[illegible]
7.3	215.7	12.8	13.6	88.5	39.8	821.4	755.0	0	8,675.0	[illegible]	[illegible]
8.8	992.2	2.3	4.3	62.6	30.6	2,182.6	3,455.8	362.9	[illegible]	[illegible]	[illegible]
0	70.1	0	2.7	8.9	5.1	285.6	382.5	0	[illegible]	[illegible]	[illegible]
0	25.9	2.4	0	4.9	2.1	80.6	376.7	12.5	[illegible]	[illegible]	[illegible]
2.6	44.1	15.3	6.4	11.2	70.0	388.3	2,772.5	0	[illegible]	[illegible]	[illegible]
1.7	70.9	5.4	5.8	21.6	7.4	352.6	510.5	[illegible]	[illegible]	[illegible]	[illegible]
.4	1,761.0	46.5	35.8	209.8	201.6	13,166.8					
.2	3,967.3	441.5	322.3	2,154.4	1,693.9	21,942.6	714.2	[illegible]	[illegible]	[illegible]	[illegible]
.8	1,958.6	458.4	144.5	1,318.9	379.6	46,809.3	23,527.6	[illegible]	[illegible]	[illegible]	[illegible]
.4	7,686.9	946.4	502.6	3,682.8	2,275.1	81,918.7	34,238.0	[illegible]	[illegible]	[illegible]	[illegible]

sector. Exports as a per cent of total gross output varied from 100 per cent in apparel manufacturing to 4 per cent in local contract construction. About 58 per cent of total gross output was exported. Total exports for all endogenous sectors can be obtained by adding the entries in the export column (Table 12). Agriculture, manufacturing, communications, and utilities accounted for approximately 79 per cent of total export transactions made by all processing sectors in 1965.

Local household consumption used approximately 12 per cent of total gross output originating in the 14 processing sectors during the period studied. However, there was a great deal of variation between sectors with respect to sales to local households as a per cent of total gross output (Figure 4). Those sectors which exhibited a relatively great dependence upon export (external) markets (Figure 3) in general show local household consumption to be a relatively small component of total final demand.

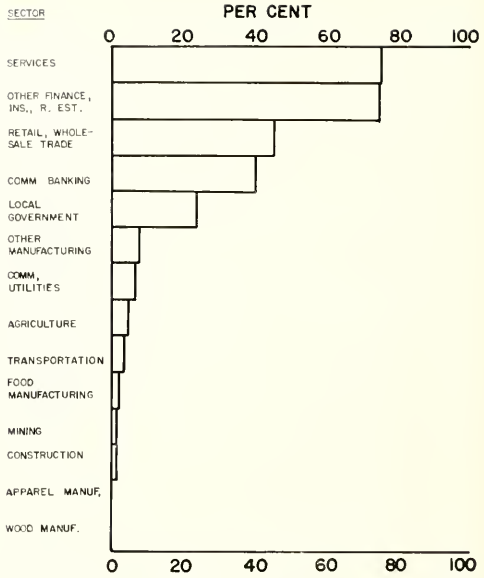

FIGURE 4. Household Consumption as a Per Cent of Total Gross Output

Final Demand
out by Industrial

TABLE 12
Estimated Distribution of Total Exports by Local Sector, 1965

Sector	Total Value of Exports (000)	%
All Local Sectors	$47,549.2	100.00
Agriculture	16,410.4	34.51
All Manufacturing	12,595.8	26.48
Food	5,263.6	11.07
Wood	3,806.1	8.00
Apparel	2,289.2	4.81
Other	1.236.9	2.60
Communications, Utilities	8,675.0	18.24
Mining	4 524.4	9.52
Trade	1,685.6	3.54
Local Government	1,382.0	2.91
Transportation	949.6	2.00
Services	522.0	1.10
Construction	493.6	1.04
Commercial Banking	278.3	0.59
Other Finance, Insurance, Real Estate	32.8	0.07

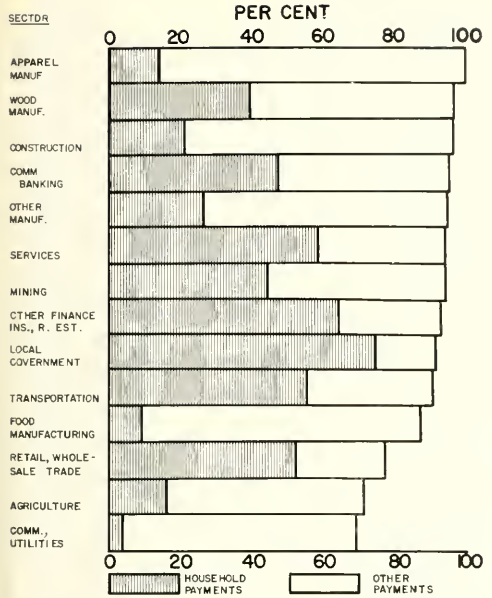

FIGURE 5. Final Payments as a Per Cent of Total Gross Output

In Figure 5 a graphic summary of final payments as a per cent of total gross output for all endogenous sectors is presented. Final payments represent expenditures made by each endogenous sector to sectors considered to be exogenous to the model, i. e., local household payments, expenditures on capital account, and imports from the rest of the world. Final payments varied from almost 100 per cent of total gross output in apparel manuacturing to 69 per cent in communications and utilities. Local household payments as a per cent of total gross output ranged from 74 per cent in the local government sector to 4 per cent in the communications and utilities sector.

STRUCTURAL INTERDEPENDENCE

The degree of interdependence between endogenous sectors of the local economy is measured by the relative magnitude of transactions in the processing quadrant of the transactions table. The per cent of the total gross output of each processing sector that is represented by endogenous transactions is presented in Figure 6.

For example, purchases by the agricultural sector from all processing sectors are equal to nearly 29 per cent of the value of the gross output of agriculture. Endogenous purchases by the apparel manufacturing sector, which purchases nearly all of its raw materials outside the region, are equal to less than 1 per cent of gross output of the sector. Apparel manufacturing firms export all of their final goods; thus endogenous sales by that sector are zero.

If final demand increases by a given amount for the products of a sector for which endogenous transactions are equal to a high per cent of its gross output, the impact on the local economy will be much greater than for an equal increase in demand for products of a sector for which endogenous transactions make up a small per cent of its gross output. Quantification of the dollar reaction of each sector in the local economy to a dollar change in the level of final demand for locally produced goods and services was achieved by the computation of a direct requirements matrix.

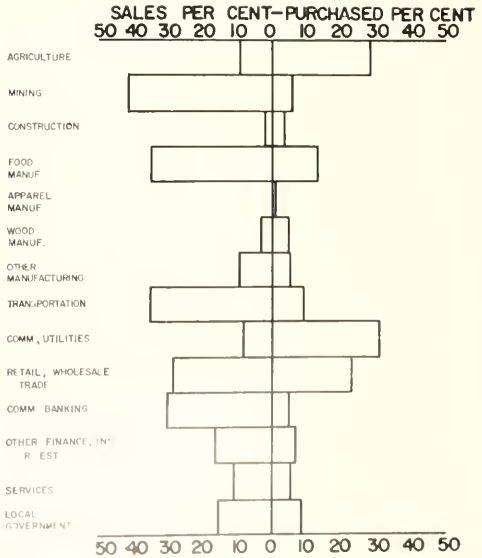

FIGURE 6. Endogenous Sales and Purchases as a Per Cent of Total Gross Output

Direct Requirements or Technical Coefficient Matrix

The direct requirements matrix, which was derived by dividing each column entry in the processing sector of the transactions table by that sector's adjusted total gross output,[1] is presented in Table 13.

Each column entry in the table is an estimate of the direct requirements from the industry named at the left, per dollar of output, by the industry named at the top. For example, the food manufacturing sector purchases $.1137 (11.37 cents) worth of products and services from agriculture for each $1.00 of gross output by the food manufacturing sector.

Table 13 also includes household payments and other exogenous payments as per cent of total gross output. These coefficients permit a summation to 1.00 for the coefficients listed in each column.

Interdependency Coefficients

The direct requirements matrix provides an estimate of the initial effect on the endogenous sectors of the local economy when one sector realizes a dollar change in total gross output. Inversion of this matrix provides an estimate of the total generative or multiplier effect for all endogenous sectors, which results from a dollar increase in final demand for the goods and services produced by each endogenous sector.

The inverted direct requirement matrix for the Upper South Branch economy is presented in Table 14. Each column entry is the total direct, plus indirect, requirements from the industry named at the left, per dollar of sales to final demand, by the industry named at the top of the table.

In brief, the inverted direct requirements matrix estimates the addition to total output in the i sector resulting from a one dollar change in final demand in the i sector. Increases in [illegible] output in excess of direct [illegible] necessary because initial (direct) [illegible] output requirements generate additional rounds of transactions within endogenous sectors of the local economy. This can best be illustrated by tracing the sectoral changes resulting from an increase in sales to final demand of one dollar in one endogenous sector. Table 15 shows column coefficients from the matrix of direct requirements (Table 13) and direct and indirect requirements (Table 14) for the agricultural sector. To increase output by the agricultural sector by one dollar, agricultural firms make direct purchases of .28819 dollars worth of goods and services from all endogenous sectors. However, this is not the total increase in output of all endogenous sectors resulting from an increase of one dollar in agricultural sales to final demand. There also will be an indirect increase in output of all endogenous sectors of .05851 dollars. This is the increase required by all endogenous sectors from each other to meet the increased requirement of the agricultural sector. Sectors selling inputs to agriculture must in turn purchase more inputs to meet increased sales to agriculture. For example, when the food manufacturing sector expands its production because of an increase in the demand for the products of agriculture, the increased demand thus generated will be felt by endogenous sectors which sell to the food manufacturing sector. The direct effect upon food manufacturing per dollar change in final demand for agricultural products is about .15 dollars. However, total output required from the food manufacturing sector to support the delivery of one dollar of agricultural output to final demand is approximately .16 dollars. The same reasoning applies to all other entries in Table 15.

In the prior discussion, households have been considered as an exogenous sector of the transactions table. Thus, output adjustments to a unit change in final demand estimated by the direct and indirect requirements matrix (Table 14) do not include the generative effect of new rounds of local household consumption expenditures.

The household sector can be considered as an endogenous sector to estimate the impact of local consumption expenditures on sectoral

[1] [illegible] defined as total gross output less net change in inventory. Net change in inventory [illegible] by sector.

Direct Dollar Requirements per Dollar Change in Final Demand by Sector

Industry Producing	Agriculture	Mining	Construction	Food Manuf.	Apparel Manuf.	Wood Manuf.	Other Manuf.	Transportation	Comm., Utilities	Retail, Wholesale Trade	Comm., Banking	Other Finance, Ins., R. Est.	Services	Local Govt.
	INDUSTRY PURCHASING													
Agriculture	.03961	0	0	.11376	0	.02032	0	.00096	0	0	0	0	0	0
Mining	.00453	0	.00379	.00046	.00018	0	.01501	0	.30279	.00416	0	.00199	.00054	.00369
Construction	.00402	.00050	.00560	0	0	0	.00153	0	0	.01034	.00507	0	0	.00387
Food Manuf.	.15178	0	0	.00118	0	.00126	0	.00249	0	.00062	0	0	0	.00273
Apparel Manuf.	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Wood Manuf.	.00505	.00019	.00338	0	0	0	0	0	0	0	0	0	0	0
Other Manuf.	.00044	0	.00375	.00110	0	.00003	.00018	.00102	0	.00956	.00349	.00398	.00049	.00747
Transportation	.00230	.04376	.00093	.00005	0	.00189	.00203	0	0	.01587	.00021	0	.00225	.00273
Comm., Utilities	.01037	.00811	.00160	.00551	.00398	.00868	.01288	.00950	.00169	.03196	.01353	.02706	.02403	.01749
Retail, Wholesale Trade	.04340	.00490	.00908	.00234	.00026	.00351	.00629	.04254	.00183	.12908	.00243	.00856	.01700	.01345
Comm. Banking	.00665	.00011	.00235	.00047	0	.00187	.00250	.01537	0	.00916	0	.00537	.00242	.00224
Other Finance, Ins., R. Est.	.00160	.00021	.00053	.00007	.00004	.00053	.00031	.00223	0	.00337	.00254	0	.00133	.00092
Service	.00322	.00034	.00201	.00065	.00031	.00477	.00629	.01454	.00025	.00574	.01617	.01273	.00301	.03077
Local Govt.	.01022	.00094	.00020	.00307	.00026	.00061	.00366	.00211	.00017	.00922	.00571	.01154	.00587	.00325
TOTAL ENDOGENOUS	.28819	.05906	.03427	.12866	.00503	.04347	.05073	.09076	.30673	.22908	.04915	.07123	.05697	.03811
HOUSEHOLDS	.16351	.44242	.20788	.08689	.14324	.38642	.26346	.55677	.04479	.51611	.46651	.64127	.58491	.74454
OTHER EXOGENOUS	.54830	.49852	.75785	.78445	.85173	.57011	.68581	.35247	.64848	.25481	.48434	.28750	.35812	.16735
TOTAL	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000

TABLE 14

Direct and Indirect Requirements Per Dollar Change in Final Demand

Industry Producing	Agriculture	Mining	Construction	Food Manuf.	Apparel Manuf.	Wood Manuf.	Other Manuf.	Transportation	Comm., Utilities	Retail, Wholesale Trade	Comm., Banking	Other Finance, Ins., R. Est.	Services	Local Govt.
	INDUSTRY PURCHASING													
Agriculture	1.05046	.00006	.00009	.12078	0	.02170	.00001	.00132	.00002	.00012	0	.00001	.00001	.00034
Mining	.00956	1.00273	.00459	.00333	.00139	.00297	.01920	.00386	.30416	.01654	.00446	.01069	.00826	.00973
Construction	.00195	.00060	1.00577	.00061	.00001	.00016	.00165	.00062	.00020	.01208	.00517	.00020	.00025	.00411
Food Manuf.	.16123	.00013	.00003	1.01955	0	.00457	.00032	.00273	.00004	.00081	.00002	.00004	.00004	.00281
Apparel Manuf.	0	0	0	0	1.00000	0	0	0	0	0	0	0	0	0
Wood Manuf.	.00538	.00019	.00396	.00061	0	1.00011	.00001	.00001	.00006	.00005	.00002	0	0	.00002
Other Manuf.	.00131	.00014	.00589	.00130	.00001	.00011	1.00031	.00159	.00006	.01120	.00360	.00120	.00075	.00771
Transportation	.00380	.01400	.00133	.00064	.00007	.00217	.00307	1.00101	.01338	.01996	.00853	.00071	.00296	.00352
Comm., Utilities	.01413	.00890	.00221	.00738	.00102	.00935	.01361	.01190	1.00447	.03793	.01433	.02819	.02508	.01917
Retail, Wholesale Trade	.05405	.00787	.01069	.00895	.00033	.00539	.00772	.04945	.00451	1.14991	.00339	.01047	.01995	.01652
Comm. Banking	.00777	.00087	.00301	.00140	.00001	.00212	.00265	.01591	.00029	.01095	1.09013	.00555	.00268	.00257
Other Finance, Ins., R. Est.	.00195	.00034	.00064	.00031	.00005	.00060	.00035	.00217	.00011	.00398	.00258	1.00008	.00142	.00105
Services	.00979	.00109	.00222	.00190	.00032	.00511	.00658	.01530	.00060	.00757	.01650	.01334	1.00317	.03125
Local Govt.	.01202	.00113	.00036	.00150	.00027	.00095	.00383	.00282	.00053	.01090	.00591	.01182	.00614	1.00369
TOTAL	1.31670	1.06890	1.03873	1.17126	1.00648	1.05531	1.05992	1.10899	1.32843	1.28110	1.05664	1.08530	1.07101	1.10249

output. In other words, changes in output by endogenous sectors increase payments to local households, i.e., wages, salaries, rents, profits, etc. In turn, increased household payments generate more demand for additional endogenous goods and services and so on. This procedure was followed, i.e., the household sector was included in the processing quadrant. A matrix of direct requirement coefficients was computed and the inverse of the matrix was obtained. The inverse matrix is presented in Table 16.

Again, each entry in Table 16 shows purchases from the industry named at the left of the table by the industry listed at the top for each unit of output sold to final demand. However, the coefficients in Table 16 include the output generated by additional consumer spending. The impact of increased consumer spending in response to an exogenous change in final demand is referred to as an induced effect.

Using the agriculture sector as an example, data in Table 16 indicate total endogenous output, excluding the local household sector, must total .45072 dollars (.74902 — .29830 dollars) in addition to the initial dollar change in demand to sustain the delivery of an additional dollar's worth of agricultural sales to final demand. Comparison with the corresponding column total in Table 14 shows that the induced effect of additional household expenditures on the gross output of the 14 original processing sectors was .10402 dollars (1.45072 dollars — 1.34670 dollars). Similar comparisons can be made with all other entries in the table to isolate the induced effect of increased household expenditures on gross output.

The totals for each of the columns in Table 16 indicate the estimated total impact on the area economy that can be expected from a dollar change in the final demand for the products of each individual sector. For example, a dollar change in the final demand for agricultural products will generate a total of $1.74; a dollar change in the final demand for the products of apparel manufacturing is estimated to generate a total of $1.24; and a dollar change in the

TABLE 15

Illustration of the Sectoral Response to a Change in Final Demand in the Agricultural Sector of the Local Economy[1]

Sector	Direct Requirements[2] (A)	Direct and Indirect Requirements (B)	Indirect Requirements[4] (C)
		Dollars	
Agriculture	.03961	.06046	.02085
Mining	.00453	.00956	.00503
Construction	.00402	.00495	.00093
Food Manufacturing	.15178	.16123	.00945
Apparel Manufacturing	0	0	0
Wood Manufacturing	.00505	.00538	.00033
Other Manufacturing	.00044	.00131	.00087
Transportation	.00230	.00380	.00150
Communications, Utilities	.01037	.01443	.00406
Retail, Wholesale Trade	.04340	.05405	.01065
Commercial Banking	.00665	.00777	.00112
Insurance,	.00160	.00195	.00035
	.00822	.00979	.00157
	.01022	.01202	.00180
	.28819	.34670	.05851

demand

TABLE 16

Direct, Indirect and Induced Requirements per Dollar Change in Final Demand

Industry Producing	INDUSTRY PURCHASING														
	Agriculture	Mining	Construction	Food Manuf.	Apparel Manuf.	Wood Manuf.	Other Manuf.	Transportation	Comm., Utilities	Retail, Wholesale Trade	Comm. Banking	Other Finance, Ins., R. Est.	Services	Local Govt.	Households
Agriculture	1.07020	.01893	.00896	.12560	.00575	.03765	.01140	.02540	.00758	.02350	.01943	.02676	.02427	.03158	.03973
Mining	.01377	1.01088	.00842	.00540	.00388	.00985	.02411	.01426	.30743	.02750	.01285	.02223	.01873	.02321	.01715
Construction	.00594	.00445	1.00758	.00159	.00118	.00342	.00398	.00554	.00175	.01727	.00944	.00566	.00521	.01049	.00812
Food Manuf.	16415	.00578	.00269	1.02100	.00172	.00935	.00344	.00994	.00231	.00841	.00581	.00805	.00730	.01216	.01189
Apparel Manuf.	0	0	0	0	1.00000	0	0	0	0	0	0	0	0	0	0
Wood Manuf.	.00543	.00030	.00395	.00064	.00003	1.00021	.00008	.00015	.00010	.00020	.00014	.00016	.00015	.00020	.00024
Other Manuf.	.00286	.00314	.00530	.00206	.00092	.00265	1.00212	.00542	.00127	.01524	.00669	.00845	.00460	.01267	.00631
Transportation	.00524	.04678	.00264	.00135	.00092	.00452	.00475	1.00436	.01450	.02280	.00339	.00465	.00654	.00812	.00586
Comm., Utilities	.02319	.02586	.01049	.01171	.00919	.02369	.02386	.03355	1.01127	.06076	.03179	.05225	.04690	.04726	.03573
Retail, Wholesale Trade	.08987	.07723	.04331	.02664	.02146	.06399	.04961	.13797	.03231	1.24322	.07480	.10882	.10913	.13134	.14604
Comm. Banking	.01162	.00833	.00652	.00330	.00228	.00841	.00716	.02543	.00327	.02098	1.00780	.01612	.01226	.01491	.01570
Other Finance, Ins., R. Est.	.00742	.00707	.00380	.00203	.00209	.00628	.00442	.01105	.00281	.01302	.00950	1.00962	.01007	.01218	.01116
Services	.03462	.04916	.02483	.01416	.01496	.04572	.03561	.07665	.01988	.07224	.06600	.08151	1.06529	.11084	.10123
Local Govt.	.01741	.01156	.00527	.00716	.00345	.00977	.01013	.01613	.00471	.02494	.01665	.02661	.01956	1.02096	.02197
Households	.29830	.57759	.27167	.14731	.17593	.38798	.34885	.73714	.23152	.77697	.59463	.81899	.74263	.95629	1.21612
TOTAL	1.74962	1.81706	1.40510	1.36995	1.24376	1.71349	1.52952	2.07319	1.64071	2.32905	1.85865	2.18988	2.07264	2.39212	1.64125

final demand for the services and products of wood manufacturing generates a total of $1.71 in the local economy.

Input-Output Multipliers

A regional input-output transactions table and the relationships derived therefrom provide information on the degree of interdependence within the region. A number of multipliers can be developed from available data. This study will be confined to the consideration of only income and employment multipliers.

INCOME MULTIPLIERS

The transactions table depicts the interdependency of local households in the local economy. With respect to industrial output, the table estimates the magnitude of sales of goods and services to local households by each endogenous sector. In addition, payments to local households by each endogenous sector in the form of wages, salaries, property income, dividends, etc., are systematically quantified.

The table of direct requirements coefficients (Table 13) and the results of each matrix inversion (Tables 14 and 16) can be used to analyze the impact of changes in final demand on local household income. Total changes in household income per unit change in final demand for output originating in each of the 14 endogenous sectors can be broken down into three components: (1) direct, (2) indirect, and (3) induced changes.

The direct component represents an estimate of the initial impact on household income per unit change in final demand. Direct changes in household payments result from a particular sector's immediate response to a change in final demand. Indirect changes arise out of output adjustments by all endogenous sectors necessary to directly and indirectly support the change in deliveries to final demand. Induced changes in household payments result from changes in household purchases of locally produced goods

[illegible] of direct and indirect requirements [illegible] change in final demand requirements [illegible] of local consumption expenditures remain at the same level despite a postulated change in household income generated by a change in final demand." Inclusion of the household sector as an endogenous sector in the transaction table is explicit recognition of the fact that a change in household receipts initiates a change in the level of local household expenditures. This change in household expenditures results in adjustments in output in the endogenous sectors and further changes in payments to local households. This change in payments to local households resulting from sectoral adjustments to an initial change in the level of local household expenditures is referred to as an induced change in household payments.

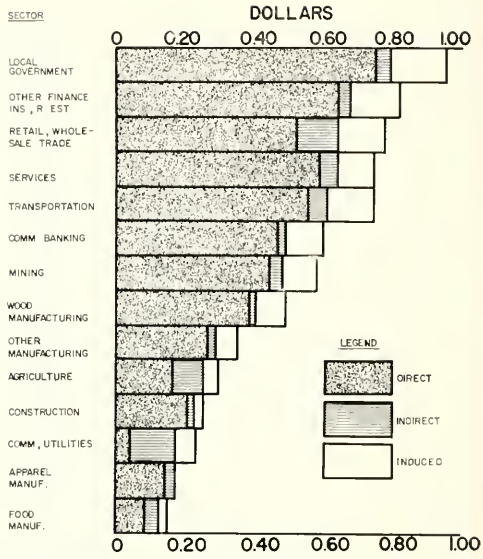

FIGURE 7. Direct, Indirect, and Induced Changes in Household Income per Dollar Change in Final Demand

Figure 7 presents a graphic summary of the direct, indirect and induced changes in local household payments associated with a change in final demand for each endogenous sector. These estimates were obtained in the following manner:

[illegible] *op. cit.*, p. 361

(1) Direct changes in household income were obtained from the household row in Table 13.

(2) Indirect changes in household income per unit change in final demand were computed as follows:

a. Each column entry in the matrix of direct and indirect requirements (Table 14) was multiplied by the corresponding household row entry in the matrix of direct requirements for the industry named at the left.

b. The column sums of the above computations were computed and the sum of the direct household requirements was subtracted from it.

(3) Subtraction of the direct and indirect household income changes from the household row of the matrix in Table 16 leaves the induced change presented in Figure 7.

Two types of household income multipliers were calculated. The Type I multiplier is an estimate of the direct and indirect change in household income per dollar change in direct payments to households by sector. The Type II multiplier includes the induced, as well as direct and indirect changes in household income as a result of a dollar change in direct payments to households. Type I and II multipliers for the Upper South Branch economy are presented in Table 17. Table 17 shows that a dollar change in household payments, as the result of a change in final demand for output originating in agriculture, is estimated to directly and indirectly generate a total of $1.50 in local household payments. When induced output changes are included, the estimate is $1.82. In every case, the Type II multiplier is larger than its Type I counterpart. This is because new rounds of household expenditures are generated within the local economy as a result of a change in final demand for output originating in any one of the endogenous sectors.

The indirect and induced changes in household income per unit change in direct household payments for endogenous sectors are presented in Figure 8. The relative sizes of the Type I and II income multipliers can be seen. The induced component is the difference between the two multipliers. These data accentuate the degree of interdependency within sectors of the local economy. Sectors which purchased relatively large portions of their non-labor inputs from other endogenous sectors had higher indirect and induced change in household income.

Caution should be used in interpreting and using the income multipliers. As is shown in Table 17, in general, there is a negative relationship between the total effect of a change in output on household payments and the size of the income multipliers. For example, a dollar change in output by the local government sector will generate a total of 95 cents additional payments to households, but the income multipliers are relatively low due to the fact that a large per cent of the total change in household payments is a direct change and very little additional activity is generated. In contrast, a dollar change in the output of the communications and utilities sector generates only 23.5 cents additional payments to households, but the income multipliers are relatively much higher because a higher per cent of the payments is indirect and induced. The income multipliers reflect the impact of changes in income — not changes in output.

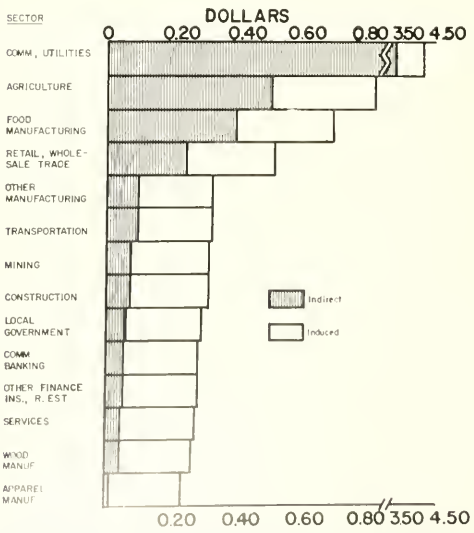

FIGURE 8. Indirect and Induced Household Income Generated as a Result of One Dollar Change in Direct Household Payments

The implications of the income multipliers presented above can be illustrated by the use of an example in which a $100,000 increase in deliveries to final demand (exports for example) is assumed (Table 18). If this increase were realized in the agricultural sector of the local economy (while the level of final demand in all remaining sectors remained constant), the direct change in household income would be $16,351. However, increased output indirectly required from other endogenous sectors of the local economy to support this increase in final demand for agricultural products is estimated to increase total payments to local households by the extent of the Type I income multiplier for the agricultural sector (1.50). Therefore, a direct increase in household income due to an increase of $100,000 in final demand for agricultural goods and services is estimated to directly and indirectly generate a total of $24.526 ($16 351 x 1.50) in household payments. If output adjustments arising from additional rounds of endogenous household consumption expenditures are included, a direct income change of $16,351 will generate an estimated $29,759 ($16,351 x 1.82) in household payments.

Examination of a sector such as apparel manufacturing which has relatively weak structural ties with other local industrial sectors, **i. e.,** most non-labor inputs are purchased outside the area, shows that a $100,000 increase in exports would directly increase household income by $14,324. Household income would be indirectly increased by $143 ($14 467 — $14 324) and induced changes would increase total household income to $17.618 ($14,324 x 1.23).

The communications and utilities sector has a relatively low direct household coefficient, **i.e.,** a $100,000 increase in exports adds less than $4 500 in direct local household payments. However, the structural relationships with other endogenous sectors are sufficiently strong so that a $100,000 increase in final demand directly

TABLE 17

Household Income Multipliers by Industrial Sector

Sector	Dollars			Income Multipliers	
	Direct Change[1] (A)	Direct, Indirect Change[2] (B)	Direct, Indirect, Induced Change[3] (C)	Type I[4] (D)	Type II[5] (E)
Agriculture	.16351	.24532	.29830	1.50	1.82
Mining	.44242	.47494	.57759	1.07	1.31
Construction	.20788	.22336	.27167	1.07	1.31
Food Manufacturing	.08689	.12114	.14731	1.39	1.69
Apparel Manufacturing	.14324	.14466	.17593	1.01	1.23
Wood Manufacturing	.38642	.40126	.48798	1.04	1.26
Other Manufacturing	.26346	.28684	.34885	1.09	1.32
Transportation	.55677	.60615	.73714	1.09	1.32
Communications, Utilities	.04479	.19037	.23512	4.25	5.17
Retail Wholesale Trade	.51611	.63889	.77697	1.24	1.51
Commercial Banking	.46651	.48896	.59463	1.05	1.28
[illegible] Finance, Insurance, [illegible]	.64127	.67348	.81899	1.05	1.28
[illegible]	.58491	.61064	.74263	1.04	1.27
[illegible]	.74454	.78628	.95620	1.06	1.29

[illegible] the change in household income per dollar change in output.
[illegible] the direct household coefficient (household row, Table 13) for the industry named

[illegible] per dollar change in output (column B) divided by direct change (column A).
[illegible] income (column C) divided by direct change (column A).

TABLE 18

Change in Total Household Income Resulting From a $100,000 Change in Output by Sector

Sector	Change in Output	Direct Change In Household Income[1]	Type I Multiplier	Direct and Indirect Change[3]	Type II Multiplier[2]	Direct, Indirect Induced Change[4]
Agriculture	$100 000	$16,351	1.50	$24,526	1.82	$29,759
Mining	100 000	44,242	1.07	47 339	1.31	57,957
Construction	100 000	20,788	1.07	22.243	1.31	27,232
Food Manuf.	100,000	8,689	1.39	12,078	1.69	14,684
Apparel Manuf.	100,000	14,324	1.01	14,467	1.23	17,618
Wood Manuf.	100,000	38,642	1.04	40,188	1.26	48 689
Other Manuf.	100,000	26.346	1.09	28,815	1.32	34 896
Transportation	100 000	55,677	1.09	60.687	1.32	73,494
Communications, Utilities	100,000	4,479	4.25	19,036	5.17	23,156
Retail, Wholesale Trade	100,000	51,611	1.24	63,998	1.51	77,933
Commercial Banking	100 000	46,651	1.05	48,983	1.28	59,713
Other Finance, Insurance, Real Estate	100,000	64,127	1.05	67,933	1.28	82,082
Services	100 000	58,491	1.04	60.831	1.27	74,283
Local Government	100,000	74,454	1.06	78.921	1.29	96.046

[1]$100 000 X the Direct Household Coefficient in Table 13.
[2]From Table 17.
[3]Direct income change X Type I multiplier; differences between figures in this table and those in Table 16 are due to rounding error
[4]Direct income change X Type II multiplier.

and indirectly yields an estimated $19,036 ($4 479 x 4.25) in total household payments. Allowance for induced changes in household income increases this estimate to $23,156 ($4,479 x 5.17). **Thus, both the size of direct changes in household income by industrial sector and the degree of structural interdependency are important in evaluating the impact on the level of household income of changes in deliveries to final demand by industrial sectors in the local economy.**

Table 19 illustrates the impact on local household income of a change in final demand for the goods and services produced by each of the 14 industrial sectors in the Upper South Branch transactions table. Output is assumed to be expanded to the extent that direct household payments are increased by $100,000. Due to variation in the magnitude of direct household payments as a per cent of gross output, increases in deliveries to final demand which are required to realize a $100,000 direct change in local household payments are estimated to vary from $134,000 (local government) to $2,232,600 (communications and utilities). Further, a comparable direct change in household payments ($100,000) would require sectoral output to be expanded by only 2.51 per cent of 1965 total gross output in the wholesale and retail trade sector but by more than 31 per cent in the other finance, insurance, and real estate sector. Type I and II income multipliers indicate the magnitude of indirect or indirect plus induced changes in household income which are associated with the $100,000 direct change in sectoral income (Table 19).

The magnitude of deliveries to final demand required to generate a comparable direct change in income and employment as well as the size of sectoral multipliers must be considered in evaluating the growth potential of an industrial sector. A sector such as agriculture has

a relatively high multiplier. Moreover, sizable indirect and induced benefits indicated by this multiplier can be realized from a small increase in final demand for agricultural products (relative to current levels of gross output). The communications and utilities sector also shows a large income multiplier (Type I = 4.25, Type II = 5.17) but direct changes in household income require a large expansion of output relative to current (1965) levels. An analogous evaluation can be made for all other industrial sectors in Table 19.

Employment Multipliers

The employment effects of a change in demand are often as important as the income effects, and changes in employment have an impact on income. Therefore, the effects on employment of a change in final demand for the output of each endogenous sector were estimated.

Changes in employment resulting from changes in final demand depend upon each endogenous sector's employment function. The assumption was made that each endogenous sector exhibits a linear and homogenous employment function.

The estimated employment in each endogenous sector was divided by the sector's total gross output to obtain a ratio expressing employment per thousand dollars of total gross output. This ratio was then used to compute the direct change in employment associated with an increase or decrease in deliveries to final demand for each endogenous sector. The following procedure was used to estimate the indirect and induced employment effects associated with a unit change in final demand:

1. Each column entry in the matrix of direct and indirect requirements (Table 14) was multiplied by the direct employment ratio for the industry named at the left.
2. The column sum of the above computa-

TABLE 19

Direct Change Required in Gross Output by Sector to Obtain a $100,000 Direct Change in Household Payments and the Impact of a $100,000 Change in Household Payments on Total Household Income

Sector	Direct Change Required In Gross Output		Direct Income	Type I	Direct and Indirect Change In	Type II	Direct, Indirect, and Induced Change
	Total[1] (000)	Per Cent	Change (000)	Multiplier[1]	Income[1] (000)	Multiplier[1]	in Income[1] (000)
Agriculture	$ 611.6	3.18	$ 100.0	1.50	$ 150.0	1.82	182.0
Mining	226.0	2.82	100.0	1.07	107.0	1.31	131.0
Construction	481.0	4.14	100.0	1.07	107.0	1.31	131.0
Food Manuf.	1,150.9	13.85	100.0	1.39	139.0	1.69	169.0
Apparel Manuf.	698.1	30.49	100.0	1.01	101.0	1.23	123.0
Wood Manuf.	258.8	6.53	100.0	1.04	104.0	1.26	126.0
Other Manuf.	379.6	23.16	100.0	1.09	109.0	1.32	132.0
Transportation	179.6	11.45	100.0	1.09	109.0	1.32	132.0
Comm., Utilities	2,232.6	21.77	100.0	4.25	425.0	5.17	517.0
Wholesale, Retail Trade	193.8	2.51	100.0	1.24	124.0	1.51	151.0
Finance, Banking	214.4	22.64	100.0	1.05	105.0	1.28	128.0
[illegible] Insurance, Real Estate	155.9	31.01	100.0	1.05	105.0	1.28	128.0
[illegible]	171.0	4.64	100.0	1.04	104.0	1.27	127.0
[illegible]	134.3	5.90	100.0	1.06	106.0	1.29	129.0

[illegible] the household row, Table 14) for each industrial sector.
[illegible] required to increase direct household payments by $100,000 by sector, divided by each

[illegible] direct change in household income.
[illegible] direct change in household income.

tion represents the direct and indirect employment requirements per thousand dollar change in final demand.

3. The above computations were also performed on the matrix of direct, indirect, and induced requirements to generate an estimate of direct, indirect, and induced employment requirements per thousand dollars change in final demand.

The total effect of a change in final demand on employment within the local community can be broken down into three components: (1) direct employment changes which result from a specific sector's response to a change in final demand, (2) indirect employment changes which result from endogenous output adjustments required to directly and indirectly support a change in deliveries to final demand, and (3) induced employment changes arising out of sectoral responses to a change in the level of local household consumption expenditures.

The ratio of direct to the sum of direct and indirect changes in employment is a Type I employment multiplier. The ratio of direct to the sum of direct, indirect, and induced changes in employment is a Type II employment multiplier. These two types of multipliers are analogous to income multipliers developed previously. Type I and Type II multipliers for each endogenous sector are presented in Table 20. Each multiplier permits a comparison of the total generative effect on local employment resulting from a unit direct change in employment. For example, a one unit direct change in agricultural employment is estimated to directly and indirectly create 1.27 units of employment. Inclusion of the induced component, i.e., the effect of increased household consumption demand, increases the multiplier to 1.39 (Table 20). Once again, relatively high employment multipliers indicate greater structural interdependence with respect to local input purchases while low multipliers are indicative of relatively weak linkages between endogenous sectors of the model.

TABLE 20

Estimated Changes in Employment Resulting From a $1,000 Change in Output and Type I and Type II Employment Multiplier by Sector

Sector	Direct Change[1]	Direct, Indirect Change[2]	Direct, Indirect, Induced Change	Employment Multiplier	
				Type I[4]	Type II[5]
Agriculture	.11057	.14049	.15402	1.27	1.39
Mining	.06739	.07574	.10200	1.12	1.51
Construction	.02583	.02975	.04210	1.15	1.63
Food Manufacturing	.04283	.06047	.06716	1.41	1.56
Apparel Manufacturing	.07907	.07936	.08736	1.00	1.10
Wood Manufacturing	.10955	.11479	.13697	1.05	1.25
Other Manufacturing	.07323	.07839	.09424	1.07	1.29
Transportation	.13267	.14635	.17987	1.10	1.36
Communications, Utilities	.00799	.03146	.04197	3.94	5.25
Retail, Wholesale Trade	.18356	.22029	.25562	1.20	1.39
Commercial Banking	.04755	.05278	.07982	1.11	1.68
Other Finance, Insurance, Real Estate	.07959	.08738	.12461	1.10	1.57
Services	.14255	.14936	.18313	1.05	1.28
Local Government	.19779	.20831	.24909	1.05	1.26

[1]Sectoral employment divided by sectoral total gross output.

[2]The column sum of each column entry in the direct and indirect requirements matrix. Type II [illegible] the direct employment requirements of the industry named at the left.

[3]The column sum of each column entry in the direct, indirect and induced [illegible] times the direct employment requirement of the industry named at the left.

[4]The direct and indirect employment change divided by the direct [illegible].

[5]The direct, indirect, and induced employment change divided by the [illegible].

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